GC864-QUAD-C2 / PY-C2
Hardware User Guide

GC864-QUAD-C2 and GC864-PY-C2 Hardware User Guide
1vv0300744 Rev.1 - 24/10/06

Making machines talk.

This document is relating to the following products:

Model	P/N
GC864-QUAD-C2	3990250681
GC864-PY-C2	3990250686

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1 Overview

The aim of this document is the description of some hardware solutions useful for developing a product with the **Telit GC864-C2 module**.
In this document all the basic functions of a mobile phone will be taken into account; for each one of them a proper hardware solution will be suggested and eventually the wrong solutions and common errors to be avoided will be evidenced. Obviously this document cannot embrace the whole hardware solutions and products that may be designed. The wrong solutions to be avoided shall be considered as mandatory, while the suggested hardware configurations shall not be considered mandatory, instead the information given shall be used as a guide and a starting point for properly developing your product with the Telit GC864-C2 module.
For further hardware details that may not be explained in this document refer to the Telit GC864-C2 Product Description document where all the hardware information is reported.

NOTICE

(EN) The integration of the GC864-C2 cellular module within user application shall be done according to the design rules described in this manual.
(IT) L'integrazione del modulo cellulare GC864-C2 all'interno dell'applicazione dell'utente dovrà rispettare le indicazioni progettuali descritte in questo manuale.
(DE) Die Integration des GC864-C2 Mobilfunk-Moduls in ein Gerät muß gemäß der in diesem Dokument beschriebenen Konstruktionsregeln erfolgen
(SL) Integracija GC864-C2 modula v uporabniški aplikaciji bo morala upoštevati projektna navodila, opisana v tem priročniku.
(SP) La utilización del modulo GC864-C2 debe ser conforme a los usos para los cuales ha sido diseñado descritos en este manual del usuario
(FR) L'intégration du module cellulaire GC864-C2 dans l'application de l'utilisateur sera faite selon les règles de conception décrites dans ce manuel
(HE) האינטגרטור מתבקש ליישם את ההנחיות המפורטות במסמך זה בתהליך האינטגרציה של המודם הסלולרי GC864-C2 עם המוצר.

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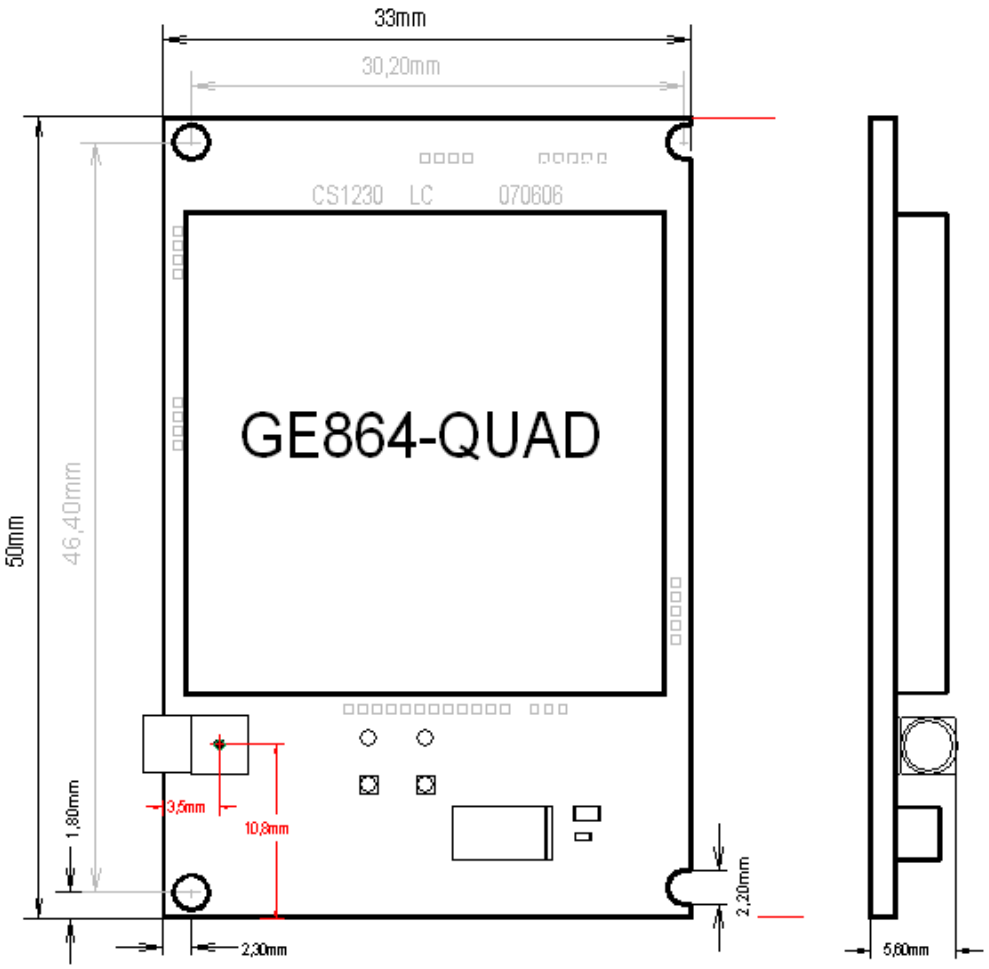
2 Mechanical Dimensions

The **Telit GC864-C2 module** overall dimension are:

- **Length:** **50 mm**
- **Width:** **33 mm**
- **Thickness:** **5.6 mm**



- **Weight:** **14gr**

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3 Board to Board connector PINOUT connections

Pin	Signal	Type	Function
1	VBATT	DC voltage	Power
2	GND	DC voltage	Power
3	VBATT	DC voltage	Power
4	GND	DC voltage	Power
5	VBATT	DC voltage	Power
6	GND	DC voltage	Power
7	VBATT	DC voltage	Power
8	GND	DC voltage	Power
9	VBATT	DC voltage	Power
10	GND	DC voltage	Power
11	VBATT	DC voltage	Power
12	GND	DC voltage	Power
13	NC	Don't connect	
14	ON_OFF*	DC voltage	Input command for switching power ON or OFF
15	SIMVCC	DC voltage	External SIM Power
16	SIMIN	DC voltage	External SIM inside detector
17	SIMRST	DC voltage	External SIM Reset
18	SIMIO	3V Only	External SIM Data I/O
19	SIMCLK	Digital Signal	External SIM Clock
20	DAC_OUT	Digital Output	Digital/ Analog converter output
21	TGPIO_01	Digital In/Out	General purpose
22	TGPIO_02/JDR	Digital In/Out	General purpose
23	TGPIO_03	Digital In/Out	General purpose
24	TGPIO_04	Digital In/Out	General purpose
25	VRTC	DC voltage	VRTC Backup capacitor
26	ADC_IN1	AC input	Analog/Digital converter input
27	ADC_IN2	AC input	Analog/Digital converter input
28	ADC_IN3	AC input	Analog/Digital converter input
29	-	-	RESERVED
30	-	-	RESERVED
31	TGPIO_07/BUZZER	Digital In/Out	General purpose/Buzzer
32	OUT	Digital Output	General purpose
33	LED	DC voltage	Status indicator led
34	VAUX1	DC voltage	Power output for external accessories
35	TGPIO_05/RFTXMON	Digital In/Out	General purpose
36	C125/RING	Digital Output	Output for Ring indicator signal (RI) to DTE
37	C108/DTR	Digital Input	Input for Data terminal ready signal (DTR) from DTE
38	C109/DCD	Digital Output	Output for Data carrier detect signal (DCD) to DTE

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39	C105/RTS	Digital Input	Input for Request to send signal (RTS) from DTE
40	C106/CTS	Digital Output	Output for Clear to send signal (CTS) to DTE
41	C103/TXD	Digital Input	Serial data input (TXD) from DTE
42	C104/RXD	Digital Output	Serial data output to DTE
43	NC	Don't connect	
44	NC	Don't connect	
45	RX_Trace	Digital Input	RX Data for debug monitor
46	TX_Trace	Digital Output	TX Data for debug monitor
47	-	-	RESERVED
48	-	-	RESERVED
49	-	-	RESERVED
50	-	-	RESERVED
51	-	-	RESERVED
52	-	-	RESERVED
53	MIC_MT+ DEC	Audio Input	Handset microphone signal input; phase+,
54	MIC_MT- DEC	Audio Input	Handset microphone signal input; phase-,
55	EAR_MT+	Audio Output	Handset earphone signal output, phase +
56	EAR_MT-	Audio Output	Handset earphone signal output, phase -
57	EAR_HF+ DEC	Audio Output	Handsfree ear output, phase +
58	-	-	RESERVED
59	MIC_HF+ DEC	Audio Input	Handsfree microphone input; phase +
60	ANALOG GND	AC voltage	

For more information about balls position and pinout of GE864 module, please refer to *1vv0300694* GE-864 Hardware User Guide

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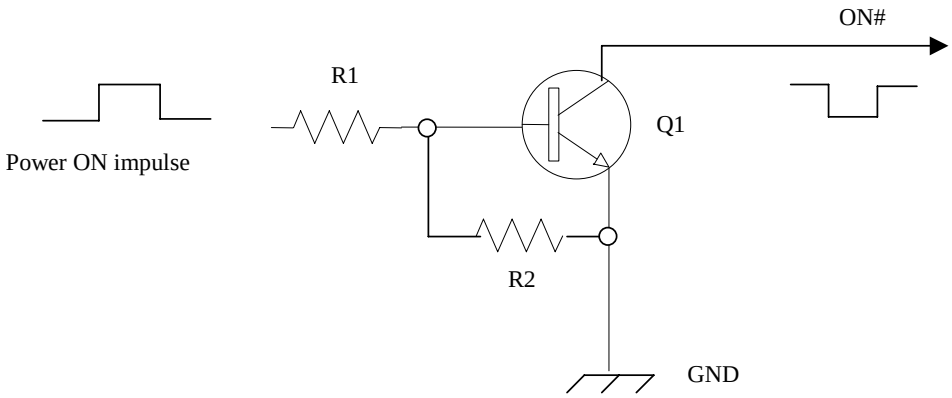
4 Hardware Commands

4.1 Turning ON the GC864-C2

To turn on the GC864-C2 the *ON#* line must be tied low for at least 1 second and then released.
The maximum current that can be drained from the *ON#* line is 0,1 mA.
A simple circuit to do it is:



NOTE: don't use any pull up resistor on the ON# line, it is internally pulled up. Using pull up resistor may bring to latch up problems on the GC864-C2 power regulator and improper power on/off of the module. The ON# line must be connected only in open collector configuration.

NOTE: In this document all the lines that are inverted, hence have active low signals are labeled with a name that ends with a "#" or with a bar over the name.

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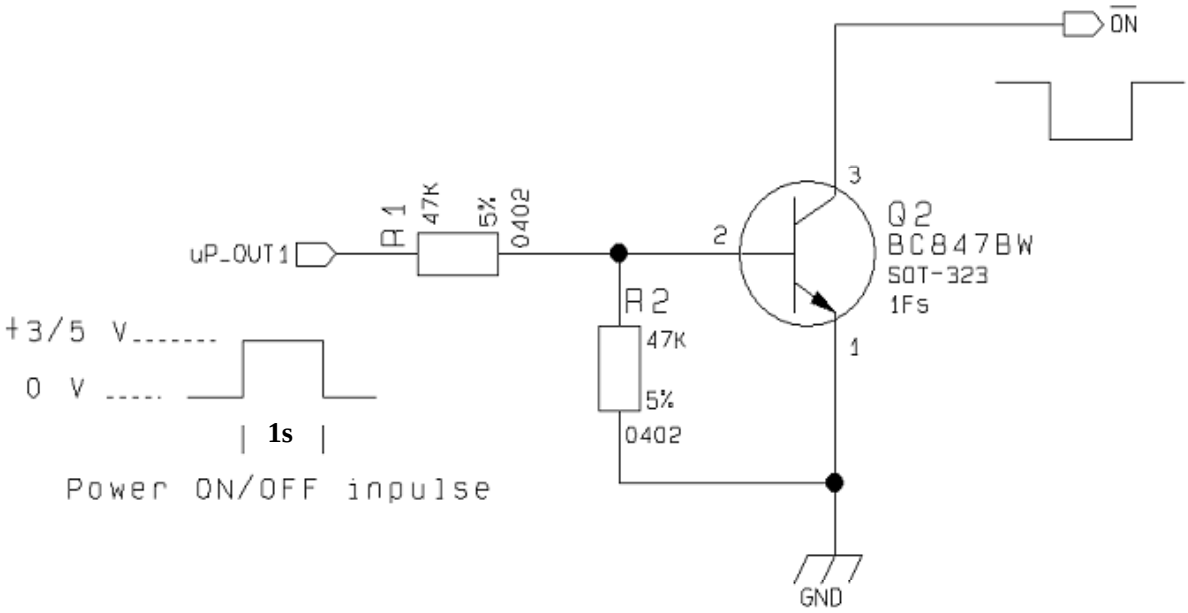
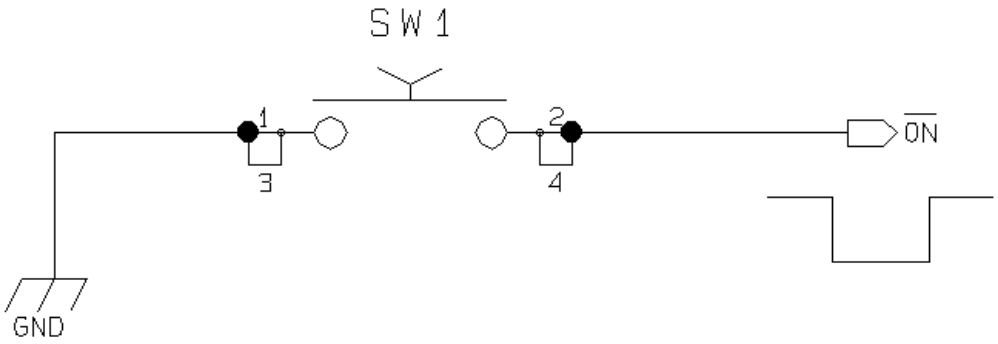
For example:
1- Let's assume you need to drive the *ON#* line with a totem pole output of a +3/5 V microcontroller (uP_OUT1):



2- Let's assume you need to drive directly the *ON#* line inserting the forecast *ON/OFF* button PL101:



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4.2 Turning OFF the GC864-C2

The turning off of the device can be done in three ways:

- by software command (refer to *1vv0300745 Rev1* GC864-QUAD-C2 / PY-C2 Software User Guide)
- by hardware shutdown
- by Hardware Unconditional Restart

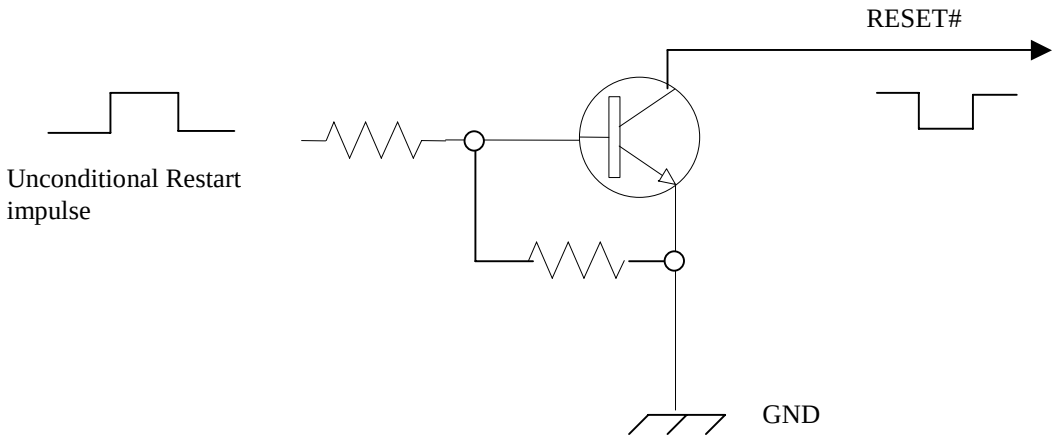
When the device is shut down by software command or by hardware shutdown, it issues to the network a detach request that informs the network that the device will not be reachable any more.

4.2.1 Hardware shutdown

To turn OFF the module GC864-C2 the *ON#* line (pin2-PL101/pin14-PL103) must be tied low for at least 2 seconds and then released.
The same circuitry and timing for the power on shall be used.

4.2.2 Hardware Unconditional Restart

The device shuts down after the release of the ON# pad.
To unconditionally restart the module GC864-C2, the *RESET#* line (pin2-PL102) must be tied low for at least 200 milliseconds and then released.
The maximum current that can be drained from the *RESET#* line is 0,15 mA.
A simple circuit to do it is:



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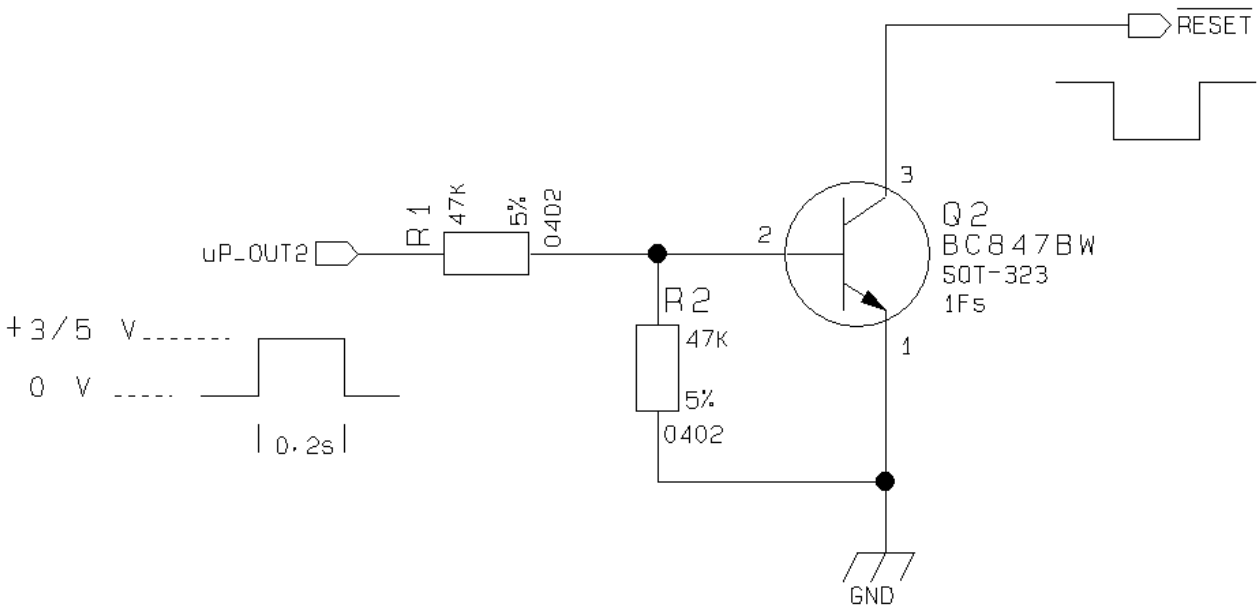
NOTE: don't use any pull up resistor on the RESET# line nor any totem pole digital output. Using pull up resistor may bring to latch up problems on the GC864-C2 power regulator and improper functioning of the module. The RESET# line must be connected only in open collector configuration.

TIP: The unconditional hardware Restart should be always implemented on the boards and software should use it as an emergency exit procedure.

For example:
1- Let's assume you need to drive the *RESET#* line with a totem pole output of a +3/5 V microcontroller (uP_OUT2):



Reset Signal Operating levels:

Signal	Min	Max
RESET Input high	2.2V*	3.3V
RESET Input low	0V	0.2V

* this signal is internally pulled up so the pin can be left floating if not used.

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5 Power Supply

The power supply circuitry and board layout are a very important part in the full product design and they strongly reflect on the product overall performances, hence read carefully the requirements and the guidelines that will follow for a proper design.

For more information please refer to *1vv0300694* GE864 Hardware User Guide

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6 General Design Rules

The principal guidelines for the Power Supply Design embrace three different design steps:
- electrical design
- thermal design
- PCB layout.

For more information about Electrical Design, Thermal Design, Power Supply PCB layout, please refer to *1vv0300694* GE864 Hardware User Guide.

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7 Antenna

The antenna connection and board layout design are the most important part in the full product design and they strongly reflect on the product overall performances, hence read carefully and follow the requirements and the guidelines for a proper design.
For more information about GSM Antenna Requirements, PCB line and Installation Guidelines, please refer to *1vv0300694* GE864 Hardware User Guide.

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8 Serial Port

The serial port on the Telit GC864-C2 is the core of the interface between the module and OEM hardware. Several configurations can be designed for the serial port on the OEM hardware, but the most common are:

- RS232 PC com port
- microcontroller UART @ 2.8V - 3V (Universal Asynchronous Receive Transmit)
- microcontroller UART@ 5V or other voltages different from 2.8V

For more information about Serial port levels, signals and connections, pinout and level translation please refer to *1vv0300694* GE864 Hardware User Guide.

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9 VAUX1 power output

A regulated power supply output is provided in order to supply small devices from module.
This output is active when the module is ON and goes off when module is shut down.

For more information about VAUX1 source please refer to *1vv0300694* GE864 Hardware User Guide.

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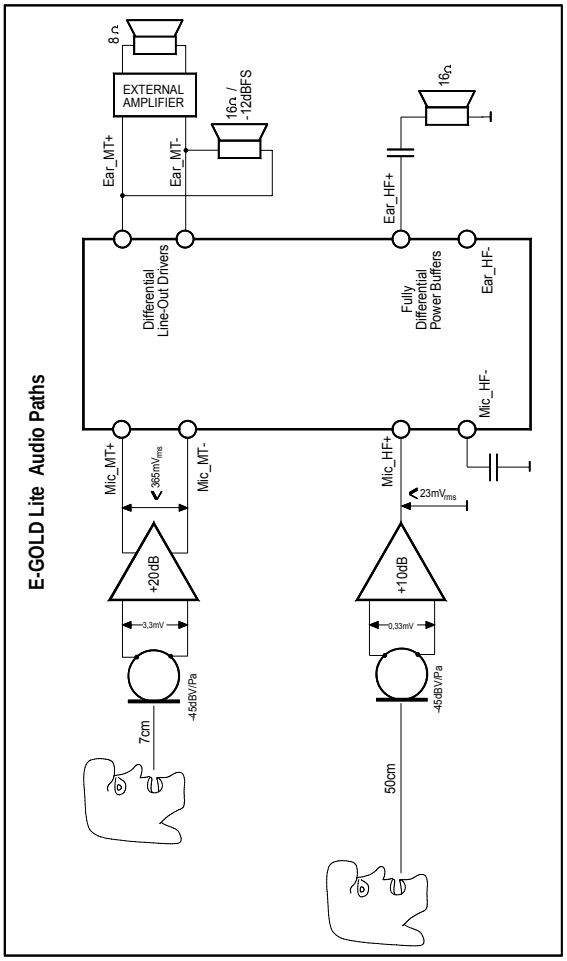
10 Audio Section Overview

The Base Band Chip of the GC864-C2 Telit Module provides two different audio blocks, both in transmit (*Uplink*) and in receive (*Downlink*) direction as shown in the see picture below:

"*MT lines*" should be used for handset function,
"*HF lines*" is suited for hands -free function (car kit).

These two blocks can be active only one at a time, selectable by AXE HW line or by dedicated AT command.
Keep in mind that *MT lines* work as Differential Input/Output circuits, while *HF lines* work as Single Ended Input/Output circuits. For these reasons they have also different audio characteristics.



10.1 Audio Lines Characteristics

10.1.1 Microphone Paths Characteristic

"Mic_MT" 1st differential microphone path

- line coupling — AC
- line type — balanced
- coupling capacitor — ≥ 100nF
- differential input resistance — 50kΩ
- differential input voltage — ≤ 1,03V_{pp} (365mV_{rms})
- microphone nominal sensitivity — -45 dBV_{rms}/Pa
- analog gain suggested — + 20dB
- echo canceller type — handset

"Mic_HF" 2nd single ended microphone path

- line coupling — AC
- line type — single ended
- coupling capacitor — ≥ 100nF
- differential input resistance — 50kΩ
- differential input voltage — ≤ 65mV_{pp} (23mV_{rms})
- microphone nominal sensitivity — -45 dBV_{rms}/Pa
- analog gain suggested — +10dB
- echo canceller type — car kit hands-free

10.1.2 Ear Paths Characteristics

"Ear_MT" Differential Line-out Drivers Path

- line coupling: — DC
- line type: — bridged
- output load resistance : — ≥ 14 Ω
- internal output resistance: — 4 Ω (typical)
- signal bandwidth: — 150 - 4000 Hz @ -3 dB
- max. differential output voltage — 1310 mV_{rms} (typ, open circuit)
- differential output voltage — 328mVrms /16 Ω @ -12dBFS
- SW volume level step — - 2 dB
- number of SW volume steps — 10

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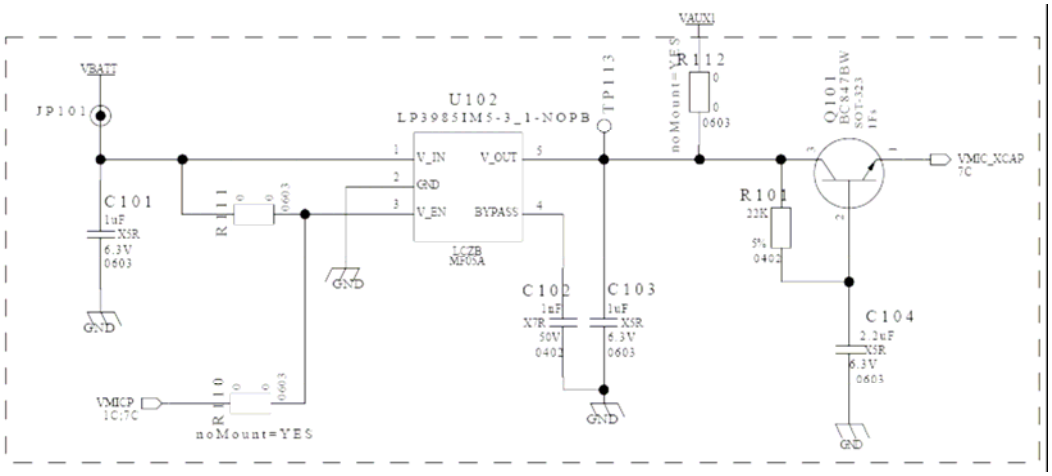
"Ear_HF" Power Buffers path

- line coupling: AC
- line type: single ended
- output load resistance : ≥ 14 Ω
- internal output resistance: 4 Ω (>1,7 Ω)
- signal bandwidth: 150 - 4000 Hz @ -3 dB
- max. single ended output voltage 656 mV_{rms} (typ, open circuit)
- SW volume level step - 2 dB
- number of SW volume steps 10

10.2 Microphone Biasing

The electret microphones usually needs a biasing voltage to work properly.
You can use the on-board circuitry on external biasing network.

10.2.1 On-board default biasing



In order to eliminate the noise coming from the power lines, the microphone bias voltage is obtained from a voltage source filtered by a capacitor multiply circuit (Q101) and connected through ***R104/R105*** to ***MIC_MT+*** line or ***R104/R106*** to ***MIC_HF+*** line.
The voltage source comes from a dedicated voltage regulator (U102), supplied directly by VBATT.
You can use also the inner VAUX1 source; in this case U102 must be removed and R112 inserted.

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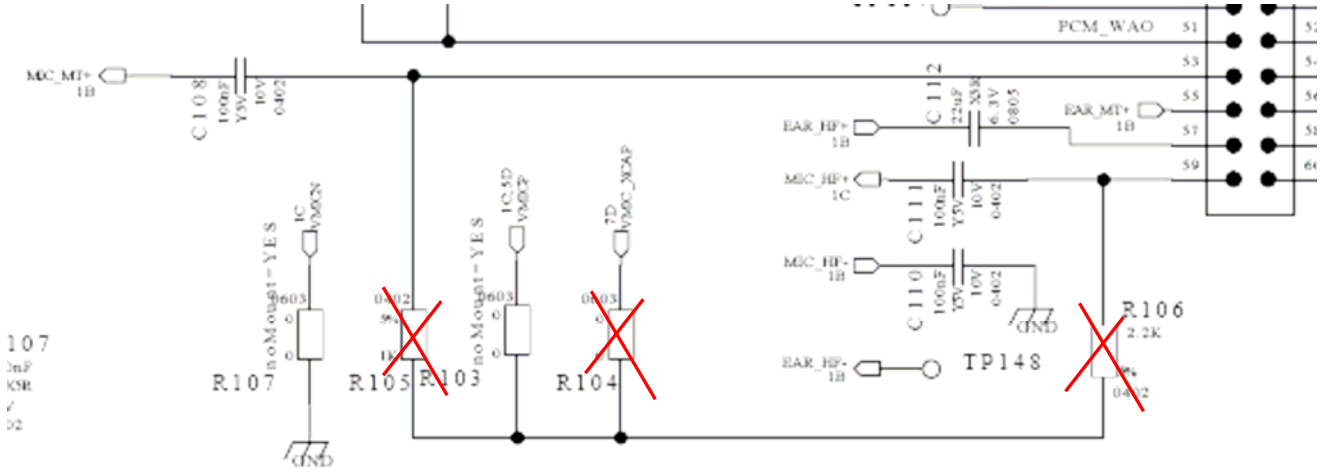
10.2.2 External biasing network

If the microphone bias voltage is generated externally, then R104/R105/R106 must not be mounted



Please refer to *1vv0300694* GE864 Hardware User Guide for more information and application notes about:
Microphone and Earpiece Electrical Characteristics, Requirements and General Design Rules.

10.3 EVK2: the Evaluation Kit for Telit Modules

Telit supplies the *Evaluation Kit for Telit modules* (EVK2) *to* assist the designer to develop his own applications based on GC864-C2 module.

The *EVK2* is composed by a mother board and a *dedicated Telit module Interface Board*, on which the module is fitted: it provides a fully functional solution for a complete data/phone application.
The motherboard has multiple power supply possibilities .It is equipped with SIM card housing, RS 232 serial port level translator, direct USB1.1 connection, and two audio input/output paths.

Please refer to *1vv0300694 GE864 Hardware User Guide* and *1vv0300704 EVK2 User Guide* for more information about its use, audio characteristics and application notes.

Furthermore, the EVK2 allows to benefit of the special features of the new Telit Module versions with *PYTHON Script Interpreter*.

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11 SIM Design Guides

In all Telit modules there are five pins for SIM card holder connection.

Please refer to *1vv0300694 GE864 Hardware User Guide* for more information about SIM Supply, EMI/EMC, ESD and application notes.

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12 General Purpose I/O

The general purpose I/O pads can be configured to act in three different ways:

- input
- output
- alternate function (internally controlled)

The *Input* pads can only be read and report the digital value (high or low) present on the pad at the read time;
The *Output* pads can only be written or queried and set the value of the pad output; the alternate function pad is internally controlled by the GC864-C2 firmware and acts depending on the function implemented.
The *"alternate function"* are supported only by *GPIO5* (which can be configured to become a RF Transmission monitor output reflecting the RF transmission activation) and *GPIO7* (which can be configured to become a Buzzer output pin).

For more information about level specifications and GPIO setting, please refer *to 1vv0300694* GE864 Hardware User Guide and *1vv0300745* GC864-C2 Software User Guide.

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13 DAC and ADC section

The GC864-C2 module provides:

- three *11-bit Analog to Digital Converters* on board (CS1230 , PL103 pin26-pin27-pin28) .

The ADCs are able to read a voltage level in the range of 0÷2 volts applied on the ADC pin input, store and convert it into 11 bit word.

- one *10 bit Digital to Analog Converter*.

This DAC is able to generate a analogue value based a specific input in the range from 0 up to 1023 , with a suitable external low-pass filter .

For more information about level specifications, the use of GPIO Pad as INPUT/OUTPUT, please refer to *1vv0300694* GE864 Hardware User Guide.

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14 Conformity Assessment Issues

The GC864-C2 module is assessed to be conform to the R&TTE Directive as stand-alone products, so if the module is installed in conformance with Telit Communications SpA installation instructions require no further evaluation under Article 3.2 of the R&TTE Directive and do not require further involvement of a R&TTE Directive Notified Body for the final product.

In all other cases, or if the manufacturer of the final product is in doubt then the equipment integrating the radio module must be assessed against Article 3.2 of the R&TTE Directive**.**
In all cases assessment of the final product must be made against the Essential requirements of the R&TTE Directive Articles 3.1(a) and (b), safety and EMC respectively, and any relevant Article 3.3 requirements.

The GC864-C2 module is conform with the following European Union Directives:

- R&TTE Directive 1999/5/EC (Radio Equipment & Telecommunications Terminal Equipments)
- Low Voltage Directive 73/23/EEC and product safety
- Directive 89/336/EEC for conformity for EMC

In order to satisfy the essential requisite of the R&TTE 99/5/EC directive, the GC864-C2 module is compliant with the following standards:

- GSM (Radio Spectrum). Standard: EN 301 511 and 3GPP 51.010-1
- EMC (Electromagnetic Compatibility). Standards: EN 301 489-1 and EN 301 489-7
- LVD (Low Voltage Directive) Standards: EN 60 950

In the Hardware User Guide and Software User Guide all the information you may need for developing a product meeting the R&TTE Directive is included.

The GC864-C2 module is conform with the following US Directives:

- Use of RF Spectrum. Standards: FCC 47 Part 24 (GSM 1900)
- EMC (Electromagnetic Compatibility). Standards: FCC47 Part 15

To meet the FCC's RF exposure rules and regulations:

- The system antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- The system antenna(s) used for this module must not exceed 3 dBi for mobile and fixed or mobile operating configurations.
- Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

Manufacturers of mobile, fixed or portable devices incorporating this module are advised to clarify any regulatory questions and to have their complete product tested and approved for FCC compliance.

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15 SAFETY RECOMMANDATIONS

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc
- Where there is risk of explosion such as gasoline stations, oil refineries, etc

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity.

We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations.

The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing the GSM network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force.

Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information's are available on the European Community website:

http://europa.eu.int/comm/enterprise/rtte/dir99-5.htm

The text of the Directive 99/05 regarding telecommunication equipments is available, while the applicable Directives (Low Voltage and EMC) are available at:

http://europa.eu.int/comm/enterprise/electr_equipment/index_en.htm

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16 Document Change Log

Revision	Date	Changes
ISSUE#0	29/09/06	Release First ISSUE# 0
ISSUE#1	24/10/06	Added product *GC864-PY-C2* in the document Pag.2 Added product name and P/N for 3990250686 version 3 Board to Board Connector Pinout connections: updated table,changed signal,type and function of pin 29 and pin 30

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